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Abstract

*NUCLEAR MAGNETOPLASMADYNAMIC ENERGY CONVERSION

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Research on closed-cycle magnetoplasmadynamic (MPD) generator systems, employing alkali metal seeded inert gases as the working fluid, is at an early stage. The nuclear heat source is the most difficult problem, but a direct gas-cooled reactor may be technically feasible. For thermal ionization, the electrical conductivities of cesium-seeded inert gases are comparable with those of potassium-seeded combustion gases at temperatures about 500°C higher, so that the closed-cycle has an immediate advantage over the coal- or oil-fired open cycle. There also exists the possibility in inert gas plasmas of achieving high electrical conductivities through non-equilibrium ionization at quite moderate gas temperatures (1200°-1800°C). If operation at such low temperatures is proved, the nuclear closed-cycle scheme becomes much more attractive.

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An attempt is made to evaluate the closed-cycle MPD concept in terms of technical and economic feasibility, and the associated long-term implications on electrical power generation. A broad research programme, based on a pilot-scale closed-loop helium-cesium facility and a series of supporting plasma physics experiments, has been undertaken at the IRD laboratories. Constructional techniques for circuits operating at gas temperatures up to 2250°C and progress in evaluating the physical processes of MPD generation are described. An assessment of the critical operating parameters, such as overall cycle efficiency and generator power density, is included.